

**Clermont County
Ohio**

Office of Environmental Quality

Water Quality Sampling

**2004
Final Report**

Horner Run Creek - North Branch Falls



Photograph compliments of Mark Birkle

Clermont County Office of Environmental Quality 2004 Water Quality Sampling Final Report

In 2004, the Clermont County Office of Environmental Quality (OEQ) focused its stream sampling efforts in two portions of the county — tributaries in the lower East Fork Little Miami River watershed, and streams in the Loveland-Miamiville area. Ambient and wet weather samples were collected from a total of eight stream sites. Additionally, fish and macroinvertebrate surveys were conducted at seven of the locations following Ohio EPA standard operating procedures.

Ambient sampling involved the collection of grab samples from seven stream sites between the months of May and October. The sample sites for the Loveland-Miamiville area and the lower East Fork tributaries are shown in Figures 1 and 2, respectively, and include the following:

Loveland-Miamiville area

- Miamiville Creek at the Loveland-Miamiville Road bridge, stream mile 0.2 (Station ID MVILLE0.2)
- Miamiville Creek at Lewis Road, stream mile 1.0 (MVILLE1.0)
- East Branch of Miamiville Creek at Ibold Road, stream mile 0.5 (EMVIL0.5)
- Horner Run at Price Road, stream mile 0.8

Lower East Fork Little Miami River watershed

- Hall Run at Roundbottom Road, stream mile 0.2 (HALL0.2)
- Shayler Run at Baldwin Road, stream mile 1.7 (SHYLR1.7)
- Wolfpen Run at U.S. Route 50, stream mile 0.1 (WLFPN0.1)

Samples were analyzed for ammonia (NH_3), nitrate-nitrite ($\text{NO}_3\text{-NO}_2$), total Kjeldahl nitrogen (TKN), total phosphorus (TP), total suspended solids (TSS), 5-day carbonaceous biochemical oxygen demand (CBOD_5), and *E. coli*. Duplicate and blank quality control samples sets were collected each sampling round. Additionally, dissolved oxygen (DO), pH, stream temperature and conductivity were monitored in the field using a YSI 600R data sonde, which was calibrated prior to each sampling day.

Wet weather samples were collected at the long-term monitoring stations established at HALL0.2, SHYLR1.7 and on Kain Run, a tributary of Lake Harsha, at State Route 276 (KAIN2.4). Samples were collected using an ISCO 6700 series refrigerated autosampler. The autosampler was programmed to collect six sets of samples at two hour intervals after the stream exceeded a pre-determined level. Level and rainfall data were recorded at the stations using an ISCO 4220 submerged probe flow meter and an ISCO 670 tipping bucket rain gauge, respectively.

The following report summarizes the results of OEQ's 2004 water chemistry sampling program. Results of the biological surveys are presented in a separate report prepared by EA Engineering.

Figure 1: Miamiville Area Stream Sampling Locations
Clermont County, 2004

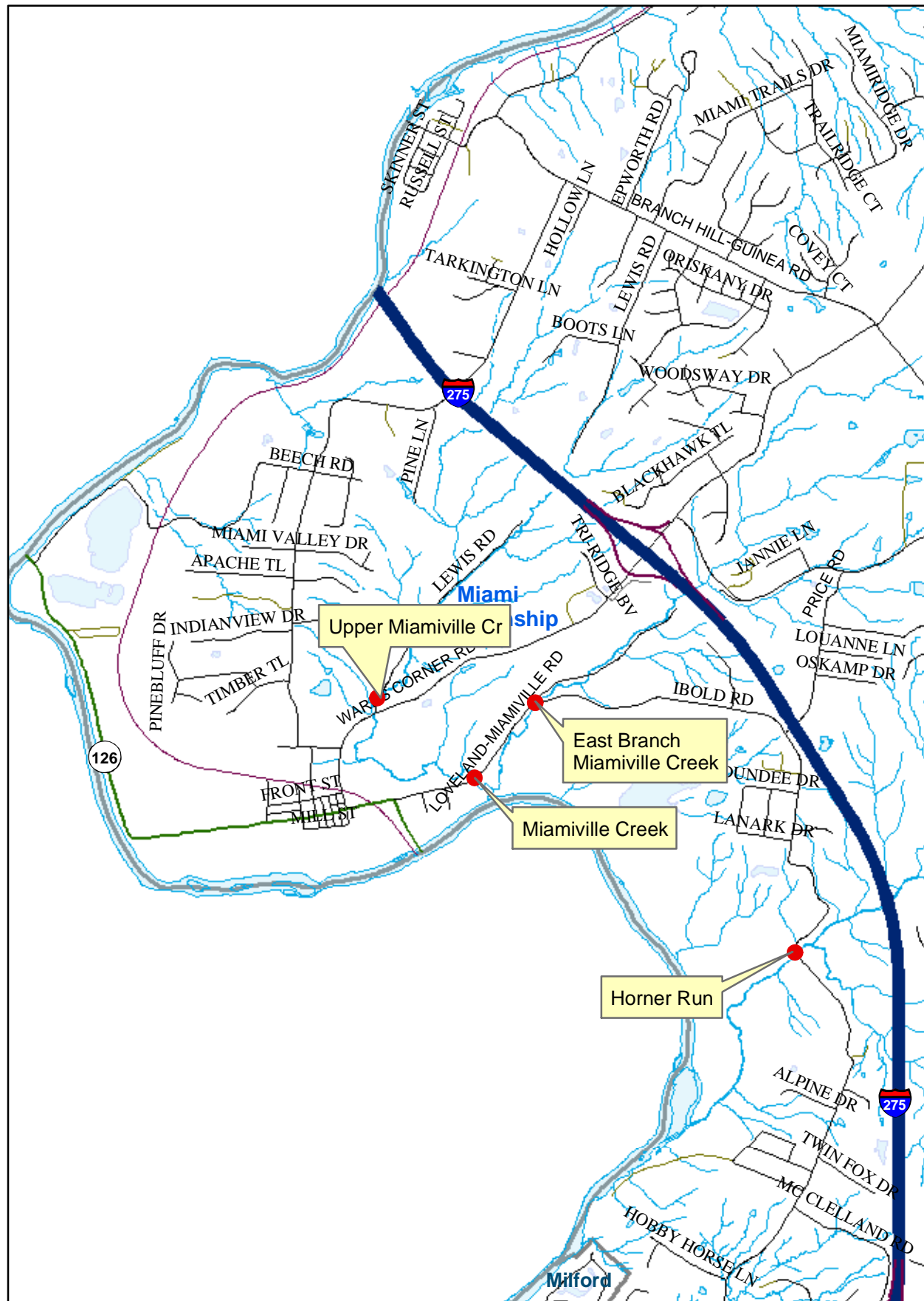
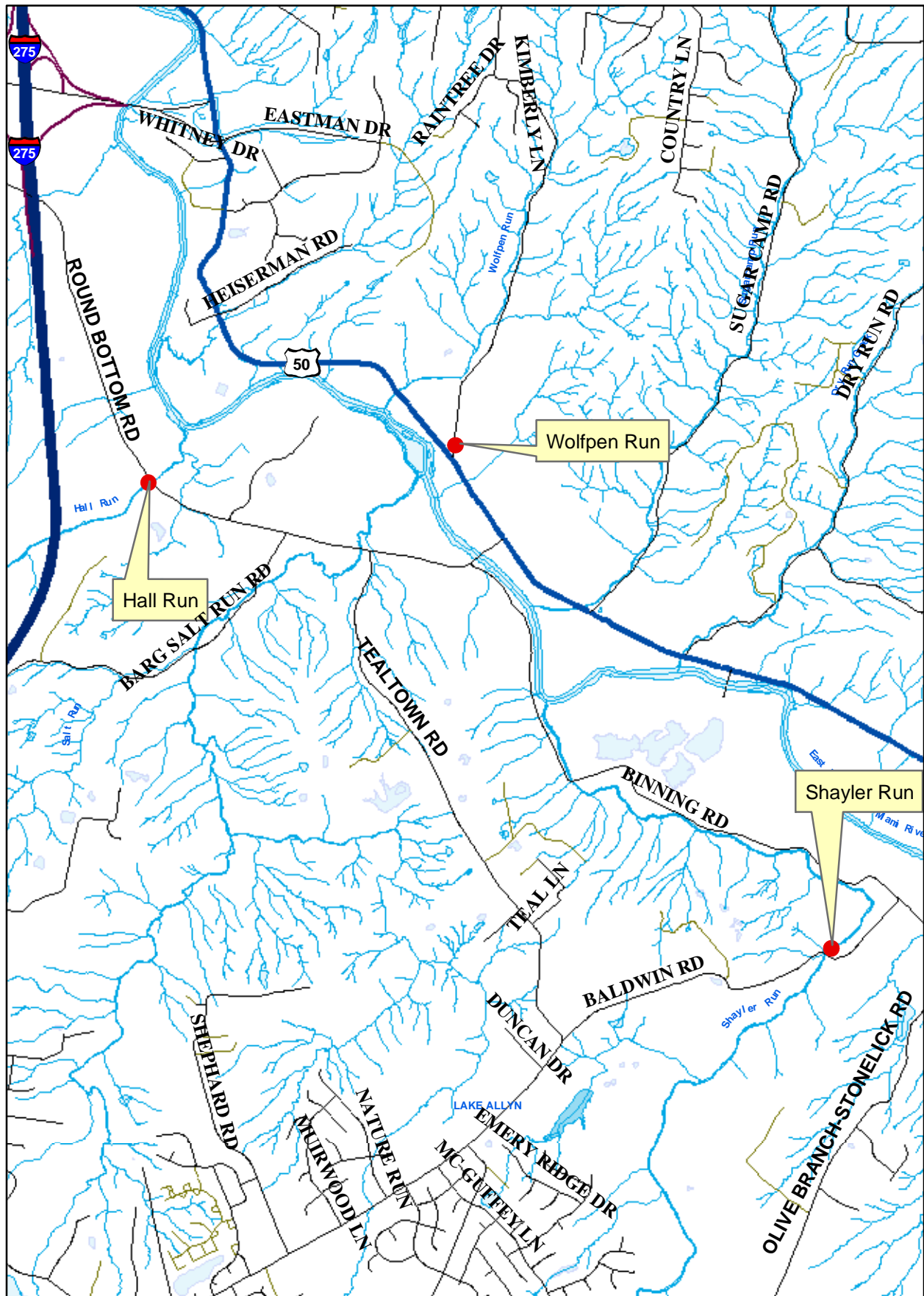


Figure 2: Stream Sampling Locations in Hall Run, Shayler Run and Wolfpen Run, Clermont County 2004



Weather and Stream Conditions During Sampling

Samples collected from the seven stream locations were categorized as either “dry” or “wet” samples, based on the amount of precipitation received over the previous 48 hours. If less than 0.1 inches of rain fell 48 hours before the time of sampling, the sample was classified as a dry weather sample. If 0.1 inches of rain or more fell anytime within the 48 hour period, the sample was categorized as a wet weather sample. The sample set dates and categories are provided in Table 1 below:

Table 1a: Weather conditions prior to time of sampling, Loveland-Miamiville area streams (based on precipitation data collected at Wards Corner wastewater treatment plant).

Sample Date	Sample Category	Sample Day Precip. (in.)	Daily Precip. one day prior to sampling (in)	Daily Precip. two days prior to sampling (in)	Stream Stage at Sampling
May 6	Dry	0	0	0	N/A
May 20	Wet	0	0.04	1.18	N/A
June 1	Wet	0	0	0.42	N/A
June 15	Dry	1.22*	0	0	N/A
June 29	Wet	0	0.13	0	N/A
July 14	Dry	0	0	0	N/A
July 28	Dry	0	0	0	N/A
August 12	Dry	0	0	0	N/A
August 26	Wet	0.02	0.04	0.12	N/A
September 8	Wet	0.03	0.33	0	N/A
September 22	Dry	0	0	0	N/A
October 7	Dry	0	0	0	N/A
October 28	Wet	0	0	0.36	N/A

All rainfall on June 15 occurred after stream samples were collected. No rainfall was received prior to sampling.

Table 1b: Weather conditions prior to time of sampling, Hall Run and Wolfpen Run (based on precipitation data collected at Lower East Fork wastewater treatment plant and stage data collected on Hall Run).

Sample Date	Sample Category	Sample Day Precip. (in.)	Daily Precip. one day prior to sampling (in)	Daily Precip. two days prior to sampling (in)	Stream Stage at Sampling (ft, Hall only)
May 6	Dry	0	0	0	
May 20	Wet	0	0.03	1.43	
June 1	Wet	0.02	0	0.57	
June 15	Wet	0.20*	0	0.40	
June 29	Wet	0	0.4	0	
July 14	Dry	0	0	0	
July 28	Dry	0	Trace	0	
August 12	Dry	0	0	0	
August 26	Wet	0.20	0.20	0	
September 8	Wet	0.60	1.0	0	
September 22	Dry	0	0	0	
October 7	Dry	0	0	0	
October 28	Wet	0	0	0.20	

Table 1c: Weather conditions prior to time of sampling, Shayler Run (based on precipitation and stream level data collected at Shayler Run stream sampling station, Baldwin Road).

Sample Date	Sample Category	Sample Day Precip. (in.)	Daily Precip. one day prior to sampling (in)	Daily Precip. two days prior to sampling (in)	Stream Stage at Sampling (feet)
May 6	Dry	0	Trace	0	1.07, steady
May 20	Wet	0	1.23 (early am)	0	1.21, falling
June 1	Wet	0	0.26	0.78	1.22, falling
June 15	Dry	0	0	0	0.85, steady
June 29	Dry	0	0	0	0.72, steady
July 14	Dry	0	0	0	0.80, steady
July 28	Dry	0	0	Trace	0.87, steady
August 12	Dry	0	0	0	0.62, steady
August 26	Wet	0.21	0.05	0	0.53, start of rise
September 8	Wet	0.20	0	0	0.57, start of rise
September 22	Dry	0	0	0	0.55, steady
October 7	Dry	0	0	0	0.11, declining
October 28	Wet	0	0.25 late pm	0	0.88, falling

While several sample sets were categorized as wet weather samples, very few were collected during the height of a storm. The samples most likely to show impacts from wet weather are those collected on May 20 (following a heavy rainstorm on May 18-19) and on September 8. Other “wet weather” samples were collected during times when it was likely that the stream had nearly returned to ambient conditions.

Ambient Stream Sampling Results

Loveland-Miamiville Area Streams

Nutrients

Three sites were sampled in the Miamiville Creek watershed, including two on the main stem (MVILL0.2 and MVILL1.0) and one on the east branch of the creek at Ibold Road (EMVIL0.5). Sampling was also conducted on Horner Run, upstream of the Boy Scout camp at Price Road (HORNR0.8). In general, ammonia concentrations were not a problem, with all samples having concentrations less than 0.1 mg/L, except the July 14 dry weather sample collected at HORNR0.8 (0.56 mg/L) and the September 8 sample collected at MVILL0.2, which had a concentration of 1.6 mg/L. This MVILL0.2 sample was collected during wet weather. There is no apparent cause for the elevated concentration on Horner Run.

Nutrients, such as nitrate-nitrite, TKN and total phosphorus, were extraordinarily high in Miamiville Creek throughout the sampling period, regardless of weather conditions. Levels were closer to average on the East Branch. Table 2 below summarizes the nutrient data for each stream.

Table 2: Nutrient Concentrations in Loveland-Miamiville Area Creeks, May-October 2004.

Sampling Location/ Parameter	NO ₃ -NO ₂ (mg/L)	TKN (mg/L)	Total Phosphorus (mg/L)
MVILL0.2			
Dry Average	20.5	0.73	2.95
Wet Average	15.6	0.89	3.66
Maximum	31.0 (Dry)	2.1 (Wet)	5.39 (Wet)
Minimum	6.9 (Wet)	<0.16 (Wet)	1.27 (Dry)
MVILL1.0			
Dry Average	4.5	0.50	0.39
Wet Average	3.3	0.79	0.44
Maximum	7.8 (Dry)	1.2 (Wet)	0.84 (Dry)
Minimum	1.6 (Dry)	0.22 (Dry)	0.13 (Dry)
EMVIL0.5			
Dry Average	0.77	0.80	0.15
Wet Average	0.73	0.85	0.24
Maximum	1.03 (Dry)	1.3 (Wet)	0.53 (Wet)
Minimum	0.51 (Wet)	0.45 (Dry)	0.12 (Dry)
HORNR0.8			
Dry Average	1.35	0.91	0.30
Wet Average	1.17	0.65	0.18
Maximum	2.22 (Dry)	1.7 (Dry)	0.82 (Dry)
Minimum	0.63 (Wet)	0.34 (Dry)	0.12 (Dry)

The results above seem to indicate a substantial contribution of NO₃-NO₂ loadings from the Wards Corner WWTP, illustrated by the extremely high concentrations at MVILL0.2, located a very short distance downstream from the plant's discharge. It is important to keep in mind that the sampling point was probably within the discharge mixing zone, and therefore, results cannot be compared to Ohio EPA criteria that apply outside the mixing zone.

Based on the high concentrations seen upstream at MVILL1.0, the plant is not the only concern in the watershed. Other contributors possibly include the discharge from the Indian Lookout WWTP, failing home sewage treatment systems, and stormwater runoff from commercial areas in the watershed. Planned upgrades at the Wards Corner WWTP, the decommissioning of the Indian Lookout WWTP, and providing public sewers to areas with septic system problems should result in substantial improvements in the water quality of Miamiiville Creek. It is recommended that additional sampling be conducted in this watershed following the sewer improvements to document any improvements.

Nutrients in Horner Run were slightly higher than those seen in the East Branch of Miamiiville Creek, and there was no significant difference between wet weather and dry weather concentrations. Potential sources of nutrient loadings in Horner Run include home sewage treatment systems and effluent from the Bramblewood WWTP.

E. coli

Samples were collected and analyzed for *E. coli* at all sites. Ohio EPA criteria states that the *E. coli* geometric mean, based on not less than five samples collected over 30-day period, cannot exceed 126 cfu/100 mL, and cannot exceed 298 cfu/100 mL in more than 10 percent of the samples. While enough samples were not collected to directly compare the results to Ohio EPA criteria, these can be used as general indicators of water quality.

As expected, the *E. coli* geometric mean was greater during wet weather than dry weather at all sites (Table 3). Concentrations were generally highest at EMVIL0.5, with seven of 13 samples exceeding 298 cfu/100 mL, and all but one exceeding 126 cfu/100 mL. This was also the only site where the dry weather geometric mean exceeded 298 cfu/100 mL, indicating possible problems with septic systems and/or illicit discharges to storm sewers or surface waters. Bacteria counts appeared to be lowest in Horner Run, though one wet weather sample was greater than 6000 cfu/100 mL.

Table 3: *E. coli* Concentrations in Loveland-Miamiville Area Creeks, May-October 2004.

Sample Site	Geo. Mean All Samples	Geo. Mean Dry Samples	Geo. Mean Wet Samples	Minimum	Maximum
MVILL0.2	305	247	313	54 (Dry)	2000 (Wet)
MVILL1.0	369	199	621	62 (Dry)	2800 (Wet)
EMVIL0.5	>712	>480	>797	89 (Dry)	7700 (Dry) >6000 (Wet)
HORNR0.8	>201	117	378	38 (Dry)	>6000 (Wet)

All E. coli concentrations are expressed in colony forming units (cfu) per 100 mL.

Total Suspended Solids

Total suspended solids (TSS) concentrations were relatively low at all sites, partly due to the fact that sampling was not conducted during the height of any significant storms (Table 4). All sites except MVILL0.2 had higher TSS concentrations during wet weather than dry weather, as expected. The MVILL0.2 dry weather average was skewed by the sample collected on June 15, which had a concentration of 117 mg/L. The HORNR0.8 location had the lowest total average and maximum concentrations.

Table 4: Total Suspended Solids (TSS) Concentrations in Loveland-Miamiville Area Creeks, May-October 2004.

Sample Site	Average All Samples	Average Dry Samples	Average Wet Samples	Minimum	Maximum
MVILL0.2	12.4	21.5	5.2	<1.0(dry & wet)	117 (Dry)
MVILL1.0	12.5	6.0	23.8	<1.0(dry & wet)	65 (Wet)
EMVIL0.5	29.9	4.7	59.4	2.4 (Dry)	290 (Wet)
HORNR0.8	11.2	6.0	17.3	1.3 (Dry)	36 (Wet)

All TSS concentrations are expressed in milligrams per liter (mg/L).

Other Parameters

Sampling data do not indicate any other problems in the Miami area streams. Dissolved oxygen concentrations never fell below 4.0 mg/L, the Ohio EPA minimum aquatic life criterion for warmwater habitat streams, and only twice fell below 5.0 mg/L, both times at MVILL0.2 (July 28, and August 26). Concentrations of CBOD₅ were almost always less than 2.0 mg/L – the maximum recorded concentration was 2.4 mg/L. Also, pH levels do not appear to be a concern at any site.

Lower East Fork Tributaries

Nutrients

Nutrient concentrations in the three lower East Fork tributaries were much lower than those seen in the Loveland-Miami area streams (Table 5). Sampling results for the sites on Hall Run and Shayler Run were very similar. Average concentrations of NO₃-NO₂, TKN and total phosphorus were higher in wet weather samples than those taken during dry weather periods, although only slightly. In both streams, NO₃-NO₂ concentrations did not rise above 1.0 mg/L, and phosphorus concentrations were less than 0.2 mg/L in all but one sample.

Nutrient concentrations in Wolfpen Run were significantly higher, particularly NO₃-NO₂ concentrations, which were two to three times greater than those seen in Hall Run and Shayler Run. Additionally, there was little difference in results between the dry and wet weather samples. Possible sources of nutrient loadings in Wolfpen Run include failing home sewage treatment systems, illicit discharges and stormwater runoff.

Ammonia concentrations were not a concern in any of the three streams, as all samples collected had concentrations less than 0.1 mg/L.

Table 5: Nutrient Concentrations in Lower East Fork Tributaries, May-October 2004.

Sampling Location/ Parameter	NO₃-NO₂ (mg/L)	TKN (mg/L)	Total Phosphorus (mg/L)
HALL0.2			
Dry Average	0.25	0.66	0.069
Wet Average	0.34	0.82	0.10
Maximum	0.86 (Wet)	1.68 (Dry)	0.14 (Wet)
Minimum	0.082 (Dry)	0.34 (Dry)	0.046 (Dry)
SHYLR1.7			
Dry Average	0.25	0.50	0.045
Wet Average	0.33	0.65	0.12
Maximum	0.87 (Wet)	1.01 (Wet)	0.21 (Wet)
Minimum	0.062 (Wet)	0.28 (Dry)	<0.026 (Dry)
WOLFPN0.1			
Dry Average	0.78	0.51	0.14
Wet Average	0.76	0.89	0.21
Maximum	1.17 (Dry)	2.69 (Wet)	0.36 (Wet)
Minimum	0.40 (Wet)	0.22 (Dry)	0.088 (Wet)

E. coli

As with nutrients, *E. coli* concentrations appear to be more of a concern in Wolfpen Run than in Hall Run or Shayler Run, and Wolfpen Run bacteria counts varied little between samples collected during dry and wet weather (Table 6). Though greater than the other two streams, *E. coli* levels in Wolfpen Run were not exceptionally high, as the geometric mean of all samples was near the Ohio EPA criterion of 298 cfu/100 mL. The highest single count seen was 2,300 cfu/100 mL, while another sample was reported as greater than 1,200 cfu/100 mL. Both samples were collected during dry weather periods, which may indicate the presence of illicit discharges in the watershed.

E. coli counts in Hall Run and Shayler Run were generally quite low. Concentrations in Hall Run were less than Ohio EPA criteria during dry weather, though counts did rise above 298 cfu/100 mL in wet weather. In Shayler Run, geometric means were less than 298 cfu/100 mL during both dry and wet weather, and only 2 of 13 samples exceeded this level throughout the sampling period.

Table 6: *E. coli* Concentrations in Lower East Fork Tributaries, May-October 2004.

Sample Site	Geo. Mean All Samples	Geo. Mean Dry Samples	Geo. Mean Wet Samples	Minimum	Maximum
HALL0.2	199	91	420	31 (Dry)	730 (Wet)
SHYLR1.7	75	31	290	7.7 (Dry)	640 (Wet)
WLFPN0.1	>289	>279	259	31 (Wet)	2300 (Dry) >1200 (Dry)

All E. coli concentrations are expressed in colony forming units (cfu) per 100 mL.

Total Suspended Solids

Total suspended solids concentrations in the three lower East Fork tributaries were very low, as shown in Table 7. However, no sampling was conducted during the peak of a significant storm, as discussed above. Concentrations were generally lower than those seen in the Loveland-Miamiville area streams. While still low, TSS concentrations in Wolfpen Run varied little between dry and wet weather, similar to the results seen for nutrients and *E. coli*. Also, the highest TSS concentration seen in Wolfpen Run occurred during a dry weather sampling period.

Table 7: Total Suspended Solids (TSS) Concentrations in Lower East Fork Tributaries, May-October 2004.

Sample Site	Average All Samples	Average Dry Samples	Average Wet Samples	Minimum	Maximum
HALL0.2	5.1	4.1	6.2	1.1 (Wet)	11.3 (Wet)
SHYLR1.7	6.0	2.0	11.7	<1.0 (Dry)	21.4 (Wet)
WLFPN0.1	8.0	9.0	7.1	<1.0 (Dry & Wet)	23.3 (Dry)

All TSS concentrations are expressed in milligrams per liter (mg/L).

Other Parameters

As with the Loveland-Miamiville area streams, sampling results did not show any problems with instream pH levels or with low dissolved oxygen concentrations, which remained above 5.0 mg/L. All but five samples have less than detectable CBOD₅ concentrations. One sample collected from Hall Run on May 20 had a CBOD₅ concentration of greater than 7.7 mg/L.

Wet Weather Stream Sampling Results

Wet weather samples were collected at the long-term monitoring stations established at HALL0.2, SHYLR1.7 and on Kain Run, a tributary of Lake Harsha, at State Route 276 (KAIN2.4). Samples were collected using an ISCO 6700 series refrigerated autosampler. The autosampler was programmed to collect six sets of samples at two hour intervals after the stream exceeded a pre-determined level. Sample sets were composited based on when they were collected in relation to the stream hydrograph. Samples collected while stream level was rising were combined and analyzed as a single sample. Likewise, samples collected while the stream was at or near its peak stage were composited and analyzed as one sample, as were samples collected while stream stage was falling. Thus, for each storm event, three sets of samples were analyzed from each autosampler and categorized as either “rising,” “peak/level” or “falling.”

Parameters analyzed include ammonia (NH₃-N), nitrate-nitrite (NO₃-NO₂), total Kjeldahl nitrogen (TKN), total phosphorus (TP), total suspended solids (TSS), and 5-day carbonaceous biochemical oxygen demand (CBOD₅). Samples were not analyzed for *E. coli*. Level and rainfall data were recorded at the stations using an ISCO 4220 submerged probe flow meter and an ISCO 670 tipping bucket rain gauge, respectively.

Hall Run

Seven storm events were sampled at the Hall Run autosampler station on Roundbottom Road. Sample dates include: May 19, July 7, July 22, July 31, August 4, September 17 and October 18. Three full sample sets were analyzed for each storm. Average, minimum and maximum pollutant concentrations during rising, peak and falling stream levels are presented in Table 8 below.

Table 8: Hall Run Wet Weather Sampling Results, May-October 2004.

Stream Stage	Ammonia	NO3-NO2	TKN	TP	TSS	CBOD5
Rising						
Average	0.11	0.80	3.8	2.7	1,710	6.2
Max	0.15	1.35	7.0	5.8	3,410	8.7
Min	<0.10	0.34	1.2	0.35	136	2.7
Peak/Level						
Average	0.11	0.79	2.2	1.5	803	4.6
Max	0.16	1.40	3.8	3.6	1,940	6.8
Min	<0.10	0.45	0.84	0.17	43	2.7
Falling						
Average	0.13	0.81	1.4	0.56	214	3.5
Max	0.32	1.88	1.8	0.88	462	5.2
Min	<0.10	0.44	0.8	0.13	18	2.7

All concentrations are expressed in milligrams per liter (mg/L).

In contrast to the ambient sampling results, several samples had detectable levels of ammonia, although most samples were still less than 0.1 mg/L and detectable concentrations were still low. The maximum concentration recorded was 0.32 mg/L during the May 16 storm.

Concentrations of $\text{NO}_3\text{-NO}_2$ during wet weather were elevated in Hall Run as expected, but not dramatically over ambient levels. Of the 18 samples analyzed, 13 (or 72 percent) had concentrations less than 1.0 mg/L. Average $\text{NO}_3\text{-NO}_2$ concentrations during the rising, peak and falling segments of the stream hydrograph were almost identical.

Sample results for other nutrients showed significantly higher concentrations than those seen during ambient sampling. Total phosphorus (TP) concentrations climbed as high as 5.8 mg/L during wet weather sampling on Hall Run, much greater than ambient maximum concentration of 0.14 mg/L. Similarly, the peak TKN level during wet weather was 7.0 mg/L, compared to a high of 1.68 mg/L during ambient sampling.

Both TP and TKN exhibited a “first flush” effect, as average, maximum and minimum concentrations were greatest for these parameters when stream levels were rising. "First flush" is the runoff that occurs at the beginning of a rainstorm. The first flush carries with it concentrations of pollutants that have accumulated during the period of dry weather between storms, which could be one day or several weeks. The first flush effect is generally thought to be more pronounced in watersheds with larger percentages of impervious area.

The majority of samples had detectable CBOD_5 concentrations, unlike those collected during the ambient sampling program, when only 3 of 13 samples were greater than 2.0 mg/L. Like TKN and TP, CBOD_5 concentrations also appear to be greatest during the initial stages of the storm, as runoff carrying the first flush entered the stream.

As expected, wet weather TSS concentrations were dramatically higher than those seen during ambient sampling conditions. Samples typically exceeded 100 mg/L and a few had concentrations exceeding 1,000 mg/L. A peak TSS concentration of 3,410 mg/L was seen during the May 19 storm event. Suspended solids concentrations were also consistently higher immediately after the onset of precipitation, as the stream was rising. Of all parameters sampled, only NH_3 and $\text{NO}_3\text{-NO}_2$ did not appear to exhibit a “first flush” effect.

Shayler Run

Six storm events were sampled at the Shayler Run autosampler station on Baldwin Road. Sample dates include: May 19, May 26, July 22, July 30-31, August 4 and September 17. Three full sample sets were analyzed for each storm. Average, minimum and maximum pollutant concentrations during rising, peak and falling stream levels are presented in Table 9 below.

Wet weather sampling results for Shayler Run were very similar to Hall Run. There were some detectable levels of ammonia; however, most samples had concentrations less than 0.1 mg/L. Concentrations for all other parameters were much greater than those seen during ambient sampling, particularly TSS, TP and TKN concentrations. Average, maximum and minimum concentrations for each parameter tended to be slightly lower in Shayler Run.

Table 9: Shayler Run Wet Weather Sampling Results, May-October 2004.

Stream Stage	Ammonia	NO3-NO2	TKN	TP	TSS	CBOD5
Rising						
Average	<0.1	0.34	1.8	0.93	580	2.9
Max	<0.1	0.54	3.7	2.0	1,320	3.3
Min	<0.1	0.11	0.73	0.24	116	<2.0
Peak/Level						
Average	0.12	0.56	2.45	1.7	1,035	4.3
Max	0.19	0.86	4.31	4.4	2,950	5.4
Min	<0.1	0.33	0.84	0.47	114	3.0
Falling						
Average	0.11	0.75	1.76	0.92	494	3.9
Max	0.13	1.5	3.53	2.5	1,940	6.5
Min	<0.1	0.39	0.56	0.27	52	2.4

All concentrations are expressed in milligrams per liter (mg/L).

One primary difference between the two sites is that the first flush effect is not readily apparent in Shayler Run. Higher pollutant concentrations are seen during peak stream levels in Shayler Run, whereas the greatest pollutant levels in Hall Run tended to be present when the stream was still rising. This was true for TKN, TP, TSS and CBOD₅ – the same parameters that exhibited first flush effects in Hall Run. This is likely due to the difference in drainage areas between the two sampling locations. Having a larger watershed, Shayler Run receives loadings from more sources and experiences greater times of concentration – that is, the time it takes for flow to get from one point in the drainage basin to another. The first flush in larger watersheds, while still present, tends to be masked. While pollutant loadings from areas close to the sampling point may be seen early, loadings from points higher in the watershed take a longer period of time to reach that same point.

Kain Run

Three storm events were sampled at the Kain Run autosampler station on State Route 276 west of Williamsburg. Sample dates include: May 25, July 22, and July 30-31. Sampling was not conducted after July due to sample equipment problems. Three full sample sets were analyzed for each storm. Average, minimum and maximum pollutant concentrations during rising, peak and falling stream levels are presented in Table 10 below.

Ammonia levels were elevated during the May 25 storms, with concentrations of 0.29, 0.25 and 0.24 mg/L during rising, peak and falling stream conditions, respectively. Ammonia concentrations were less than detectable levels during the other two storms. This is likely the result of runoff from agricultural fields following spring fertilizer applications.

Concentrations of NO₃-NO₂ were similar to those seen in samples collected at Hall Run and Shayler Run, and did not change much during the sampling period for each storm event.

Table 9: Kain Run Wet Weather Sampling Results, May-July 2004.

Stream Stage	Ammonia	NO3-NO2	TKN	TP	TSS	CBOD5
Rising						
Average	0.16	0.97	3.7	2.2	1,205	6.7
Max	0.29	1.4	5.1	3.4	1,890	7.9
Min	<0.1	0.40	2.2	0.92	520	5.4
Peak/Level						
Average	0.15	0.92	2.7	1.5	747	6.8
Max	0.25	1.2	4.1	2.8	1,550	7.6
Min	<0.1	0.31	2.0	0.73	94	6.0
Falling						
Average	0.15	0.85	2.0	1.1	576	5.9
Max	0.24	1.3	3.3	1.8	812	6.3
Min	<0.1	0.30	1.4	0.49	248	5.5

All concentrations are expressed in milligrams per liter (mg/L).

Instream concentrations of TKN, TP and TSS were also similar to wet weather levels in Hall, and also tended to be highest when the stream level is rising. Though the first flush effect was present, it was not as pronounced as in Hall Run, possibly due to less impervious area in this primarily agricultural watershed. Suspended solids concentrations in Kain Run tended to remain at higher levels for longer period of time than other two streams, probably due to continued runoff from agricultural fields.

Levels of CBOD₅ were high and relatively consistent throughout the sampling period for each storm, though a slight decrease in concentrations was seen when the stream level was falling.

Conclusion

The 2004 water quality sampling program identified several areas of concern, the most significant of which is the exceptionally high nutrient concentrations in Miamiiville Creek. The nutrient levels seen in the main stem of Miamiiville Creek were not seen in the east branch of the creek at Ibold Road, although total phosphorus concentrations are a minor concern. E. coli concentrations were elevated during dry weather and were higher than the Lower East Fork Tributaries, indicating possible problems with home sewage treatment systems, sanitary sewer overflows or illicit discharges to the storm sewer system. Nutrients are also a small issue in Horner Run, as the average NO₃-NO₂ and TP concentration were slightly greater than 1.0 mg/L and 0.1 mg/L, respectively. Likely contributors of nutrient loadings to Miamiiville Creek include the Indian Lookout and Wards Corner WWTP, failing home sewage treatment systems, and stormwater runoff from commercial areas. Planned upgrades at the Wards Corner WWTP, the decommissioning of the Indian Lookout WWTP, and providing public sewers to areas with septic system problems should result in substantial improvements in the water quality of Miamiiville Creek in the near future.

In the lower East Fork tributaries, ambient nutrient concentrations were higher in Wolfpen Run than in Hall Run or Shayler Run, although they were not exceptionally high, as in Miamiiville Creek. The results also show high *E. coli* concentrations during dry weather in Wolfpen Run, which could indicate failing home sewage treatment systems, sanitary sewer overflows or illicit discharges to the storm sewer system. Hall Run and Shayler Run easily met state *E. coli* criteria during dry weather.

Wet weather sampling conducted at the three autosampler stations on Hall Run, Shayler Run and Kain Run, show significant nutrient, CBOD₅ and solids loadings during wet weather. There appears to be a first flush effect for total phosphorus, TKN, TSS and CBOD₅, particularly in Hall Run and Kain Run, as average, minimum and maximum concentrations for these parameters were at their highest levels when the stream level was rising.

Ammonia, dissolved oxygen and pH do not appear to be a problem in any of the streams sampled, in dry or wet weather. Also, total suspended solids concentrations were very low during periods of dry weather.

Recommendations

Follow-up monitoring in Miamiiville Creek watershed is recommended after the construction of the new Wards Corner wastewater treatment plant is completed. Sampling should also be extended to the Little Miami River, upstream and downstream of the plant discharge. Efforts should be made to sample during or immediately after significant storm events.

Elevated *E. coli* concentrations were seen in the East Branch of Miamiiville Creek and Wolfpen Run during dry weather. The Office of Environmental Quality should work with the Sewer District, the Stormwater Department and the Health District to identify sources of dry weather loadings in these two streams.

Wet weather sampling conducted at the three autosampler stations show a first flush effect for total phosphorus, TKN, TSS and CBOD₅. Stormwater management efforts should focus promoting and implanting best management practices that are effective in capturing the first flush.